

RESEARCH ISSUES AND INITIATIVES

Cancer Report Examines Environmental Hazards

In its new report, *Reducing Environmental Cancer Risk: What We Can Do Now*, the President's Cancer Panel (PCP) for the first time highlights the contribution of environmental contaminants to the development of cancer.¹ The panel also points out the great need for increased research on environmental risk factors. In a letter to the President that prefaces the report, the panel wrote that "the true burden of environmentally induced cancer has been grossly underestimated."

The PCP was established in 1971 by the National Cancer Act, the first salvo in former President Nixon's "war on cancer." The panel annually reports to the president on the activities of the National Cancer Program, which Jennifer Burt, special assistant to the PCP, describes as "anything that has to do with cancer in the United States." Current panelists are Margaret Kripke of the University of Texas MD Anderson Cancer Center and LaSalle D. Leffall of Howard University College of Medicine, both appointed by George W. Bush; an open third position awaits appointment by the Obama administration, Burt says.

Past PCP reports have focused on the contribution of lifestyle to cancer, but Kripke says those reports were criticized for not reviewing the contribution of environmental exposures. The panel therefore chose to dedicate this report to environmental risk factors. In developing the report, the panel reviewed more than 400 scientific reports and heard testimony from 45 invited experts at four public meetings.

The report outlines research on consumer products, combustion by-products, and agricultural chemicals used in residential and commercial landscaping. It highlights cancer attributable to radiation and points out that military activities and unnecessary medical X rays are sources of exposure that can increase cancer risk, especially among children.

Although 60% of U.S. cancer deaths are attributed to lifestyle factors such as smoking, lack of exercise, and poor diet,² the factors

contributing to the remaining 40% are a mystery, Kripke says. But the panel did not attempt to characterize the percentage of cancers that might be linked to environmental exposures. "We don't have any real idea of the contribution of environmental factors to human cancer," Kripke says. The report points out that most cancer research focuses on genetic and molecular mechanisms behind the disease.¹

Several environmental scientists were relieved to see the report take such an honest tone about the need for research. "They really point out where we have huge gaps of data," says Deborah Swackhamer, a professor of environmental chemistry at the University of Minnesota and chair of the U.S. Environmental Protection Agency's independent Science Advisory Board. "I think the science they used to back up the report is very mainstream," she adds.

The American Cancer Society (ACS) agrees with 85–90% of the panel's report, says Otis Brawley, ACS chief medical officer. Yet Brawley and other cancer researchers fear the emphasis on environmental factors may divert the general public from making positive lifestyle changes at a time when an estimated 41% of Americans will develop cancer during their lives and 21% will die of the disease.³ Michael J. Thun, vice president emeritus of epidemiology and surveillance research for the ACS, says, "It would be unfortunate if the effect of this report were to trivialize the importance of other modifiable risk factors that, at present, offer the greatest opportunity in preventing cancer."⁴

Catherine M. Cooney, a science writer in Washington, DC, has written for *Environmental Science & Technology* and *Chemical Watch*.

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The Beat by Erin E. Dooley

FDA Urges Judicious Use of Antimicrobials in Livestock

In June 2010 the U.S. FDA issued draft guidance calling on food animal producers to use medically important antibiotics for food-producing animals only when necessary and with veterinary oversight.¹ The agency

proposes to phase in voluntary measures that would limit antimicrobial use in animals in a bid to limit the development of drug-resistant bacteria. The FDA is most concerned about limiting the use of drugs given to promote growth in animals and those that are administered continuously through feed and water. The draft guidelines will be open for comment through the end of August.

Link Between Air Pollution, Temperature, and Sleep-Disordered Breathing

Researchers have found novel evidence for a link between air pollution and diminished sleep quality, a potential intermediate step toward cardiovascular disease.² Using data from the Sleep Heart Health Study, the researchers found evidence that increases in PM₁₀ and temperature independently affected nighttime hypoxia and sleep-disordered breathing, a group of conditions that includes sleep apnea and may affect up to 17% of U.S. adults. Although sleep-disordered breathing and air pollution have

both been linked separately to an increased risk for cardiovascular disease, it is not yet known whether or how air pollution might adversely affect cardiovascular risk by increasing sleep-disordered breathing.

Some Organic Pesticides Not So Clean

A two-year study has found that, compared with several new synthetic insecticides, some organic insecticides were more harmful to predator organisms (which help control target pests) and had a more negative overall environmental impact.³ In addition, in order to effectively control pests, organic pesticides often were used in higher volumes. The authors conclude that all pesticides must be evaluated using an empirically based risk assessment, "because generalizations based on chemical origin do not hold true in all cases."

Gulf Oil Spill Response Map

Geoplatform.gov/gulfresponse is a new online resource developed by NOAA



REMEDIATION

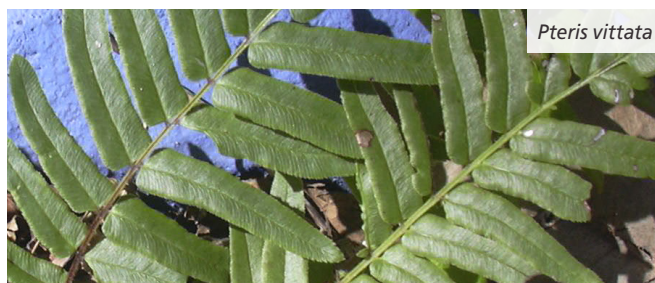
The Gene behind Arsenic Hyperaccumulation

Pteris vittata (brake fern) has been shown to accumulate large amounts of arsenic taken up from soil,¹ in one study removing more than a quarter of the soil arsenic within 20 weeks.² Now researchers have isolated the gene responsible for this feat: *ACR3*, which encodes a protein that pumps the metal into the vacuoles of plant cells.³ “Plants sequester toxicants in these vacuoles—we call them the plant’s trash can,” says principal investigator Jo Ann Banks, a professor of botany at Purdue University.

ACR3 is an arsenite efflux transporter gene found only in gymnosperms (nonflowering plants).³ Banks and horticulturist David Salt, also of Purdue University, identified *ACR3* in *P. vittata* by using a mutant yeast strain that lacks *ACR3* and dies when exposed to arsenic. The team inserted thousands of genes from *P. vittata* and found the one that corrected the deficiency, allowing the mutant to tolerate arsenic. They also showed that arsenic exposure stimulated *ACR3* activity. Fern gametophytes grown in an arsenic-laced medium produced 35 times more *ACR3* transcripts than those grown without arsenic. Moreover, ferns grown hydroponically in arsenic medium confirmed that *ACR3* activity was also highly induced in the roots.

As for what happens when the arsenic-laden plants die, Banks says, “The plants are ashed or composted to reduce biomass. There are a few labs researching how to convert the leftover arsenic into nontoxic organic arsenic compounds.”

Ferns are not the only plants that sequester arsenic. Crops such as rice have been shown to accumulate levels of arsenic high enough to threaten human health,⁴ making it important to learn how plants transport, store, and tolerate arsenic. Such information could lead to ways to manipulate rice plants to restrict arsenic to the roots and prevent contamination of edible grains. “Or we may even devise a way to keep rice plants from taking up arsenic at all,” says Banks.



Pteris vittata

“If this gene can be cloned into problematic crops such as rice, arsenic burdens in edible parts may be greatly reduced,” agrees Andrew Meharg, chair of biogeochemistry at the University of Aberdeen, United Kingdom. He adds that the new study “is a major advance in our understanding of how plants that concentrate high levels of arsenic are able to tolerate the toxic element.”

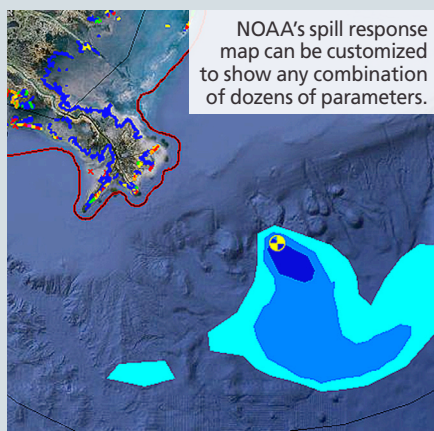
Landscapers currently plant *P. vittata* to clean up soils contaminated with arsenic from pesticides and pressure-treated lumber.⁵ However, the fern naturally grows only in warm climates such as Florida. Perhaps cold-tolerant plants could be programmed with *ACR3* to hyperaccumulate arsenic, too. Joseph Graziano, a professor of environmental health at Columbia University in New York City, notes, “It seems possible that the discovery of this gene could lead to the creation of genetically modified plants or trees with the ability to remove significant amounts of arsenic from contaminated soils.”

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Forest Starr & Kim Starr



in partnership with other agencies and stakeholders to offer near real-time data on the federal response to the *Deepwater Horizon* oil spill in the Gulf of Mexico. Visitors can use an interactive map to plot the latest available information about the spill’s trajectory, fishery closures, wildlife data, and locations of deployed research vessels. The map also highlights coastal areas where oil and tar balls have been observed

and gives details about the extent of these problems and the environmental sensitivity classification of the affected areas.

EPA Proposes New Power Plant Pollution Regs

Emissions from power plants can be transported hundreds of miles, affecting the health of populations far from the pollution’s source. The U.S. EPA has proposed regulations to curb emissions of sulfur dioxide and nitrogen oxides at their source.⁴ The proposed regulations would take the place of the 2005 Clean Air Interstate Rule, which the DC Circuit Court ordered the EPA to revise in 2008. The proposed regulations outline three possible approaches for emissions reductions, all of which involve some version of a cap-and-trade system.

Oil Spills May Affect Seawater Arsenic Levels

Recently published work suggests oil pollution may render the seafloor unable to filter out arsenic that occurs naturally

in the ocean and is introduced by drilling operations and oil spills.⁵ Sediments on the seafloor naturally bind arsenic, removing it from seawater. The authors of the new laboratory study found that low pH levels in seawater created a positive charge on samples of goethite (an iron oxide that is one of the most abundant compounds in ocean sediments), which then attracted negatively charged arsenic. Adding oil to the water created a physical barrier on the goethite and weakened the attraction between the two minerals. If oil pollution causes similar effects in ocean waters, the authors speculate arsenic may concentrate in the food chain to potentially harmful levels.

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